

TIGERS, RICE, SILK, AND SILT

ENVIRONMENT AND ECONOMY IN
LATE IMPERIAL SOUTH CHINA

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“FIRS AND PINES A HUNDRED SPANS ROUND”:

THE NATURAL ENVIRONMENT OF LINGNAN

To begin this study with a chapter subtitled “the natural environment” followed by one on “human settlement” presents something of a false dichotomy between nature on the one hand and people on the other, for as ecologists have insisted, human beings are a part of a broader ecosystem. Moreover, people are “in” the environment in another sense as well: as the observers. To describe the natural environment of south China requires looking through two lenses, one of which has been crafted in our times, the other of which is provided by Chinese sources. Our times focus the description in a particular way. Historians have only lately begun to locate their work within the context of “environmental history,” and with good reason, for it was in the 1960s and 1970s that scientists’ warning bells about the dangers of environmental degradation began to be heard. Historians cannot be blamed too much for creating the field of environmental history only in the context of these contemporary concerns about pollution of the land and air, depletion of energy sources, deforestation of the tropics, and global warming. Given this context, the kinds of questions environmental historians have been asking about the past have been conditioned by these contemporary concerns. I too have been concerned about global warming, the destruction of forests and wetlands, and the fate of the large cats, and these concerns have found their way into this book, certainly opening up some avenues of investigation, but just as surely closing down others.

Just as the issues of our times filter the ways in which we perceive the environment, so too did the concerns and views of the people who left written records select out what they saw and reported in their documents, whether these observers lived in the tenth or the eighteenth century. For better or worse, these observers were mostly Chinese, with all of the literary and organizational skills they possessed, but also with beliefs, biases, and prejudices about other peoples and about nature. Thus, even if we want to know more about forests and the way of life of non-Chinese inhabitants, for instance, we have to do so through the eyes of people who placed the highest value on settled agriculture. Sometimes we might learn what we want to know, but at other times the Chinese observers may have been blinded by their value system

and so failed to report about phenomena we might think were interesting or relevant.

The limitations of traditional historical sources can be augmented, at least with respect to significant aspects of the environment, by more recent observations and by scientific studies. To see the mountains and the delta, to sense the amount and timing of the rains, to see the rice grow, or to hear the snarl of the tiger outside a village wall, we need not rely solely upon sources from the period under consideration, but may without too many caveats draw upon sources from other times and places.

The purpose of this section on the environment thus neither is intended to be, nor could it be, a description of all of the interlocking ecosystems that historically comprised the south China environment. The task would be too gargantuan, even if I wanted to do it. I am a historian, not an ecologist, and the approach taken here is open to the charge of being anthropocentric, for I am indeed interested here in the environment insofar as it related to the human activity of securing a livelihood from the soil. With that caveat in mind, let us turn our attention to the south of China.

Physical Landscape

Braudel entitled the first section of his book on the Mediterranean in the Age of Philip II, "Mountains Come First."¹ That holds for us too, not just because it makes geologic or historical sense, but also because it causes us to change the perspective from which we view south China. For if we first examine a standard map of China and locate the space now occupied by the two provinces of Guangdong and Guangxi, we see that the region of our concern is coastal, straddling the Tropic of Cancer. Indeed, most Americans and Europeans looking at a map of China will read it first from the east or southeast looking toward the west or northwest, as if on a plane flying westward to China. This reading of the map conforms both to the direction most Americans read and tell their own history – from the east looking west² – and to the way in which Europeans first encountered China. From this perspective, the first elements we see are the coasts and the coastal cities, and only later, after some exploration of this fringe, do our eyes move inland to the great river systems and mountain ranges of China.

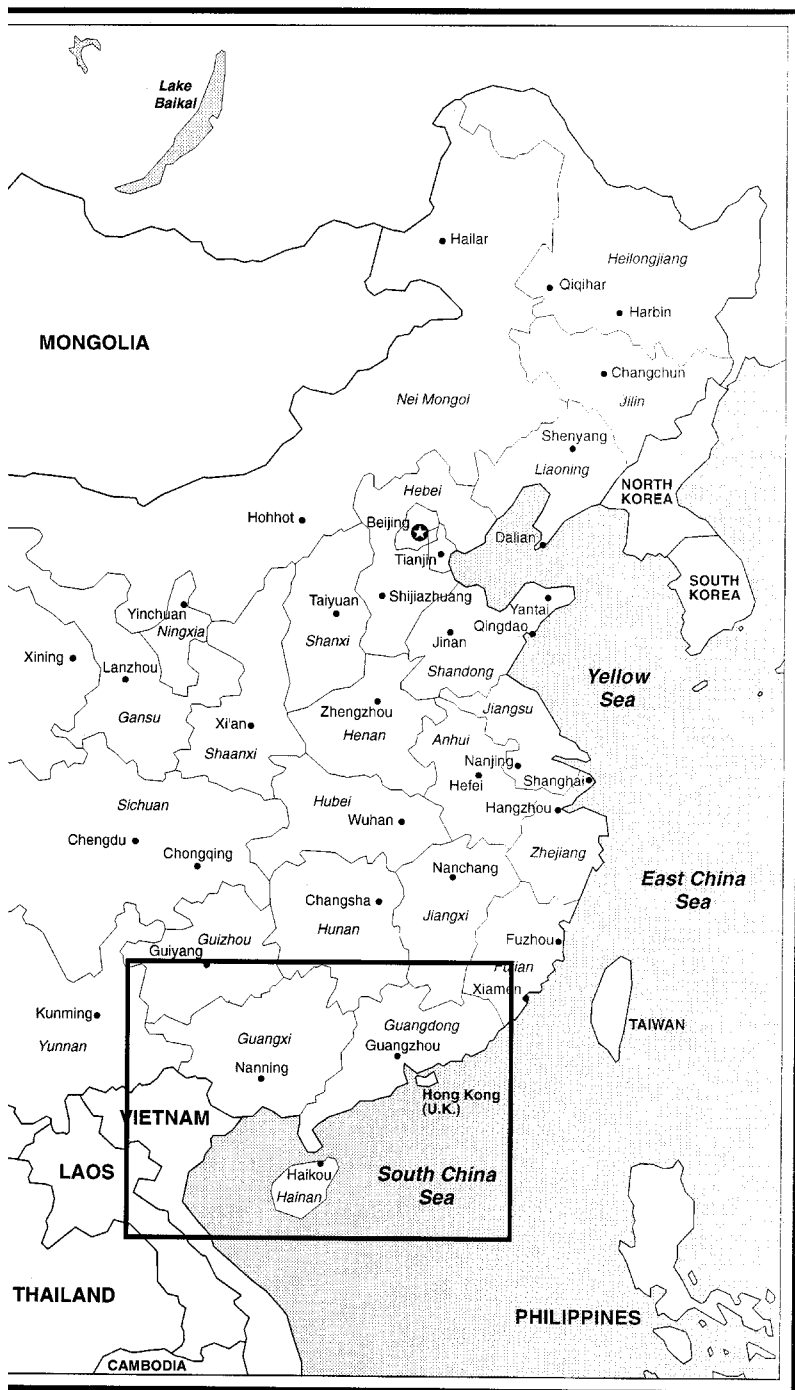
But if instead of the usual east-to-west reading of China, we adopt a Chinese reading of their own geography, then we will begin to see it from the north looking toward the south. Chinese civilization originated north of the

¹ Fernand Braudel, *The Mediterranean and the Mediterranean World in the Age of Philip II*, Siân Reynolds, trans. (New York: Harper and Row, 1972), vol. 1: 25–52.

² Dee Brown made this point elegantly in *Bury My Heart at Wounded Knee* (New York: Holt, Rinehart, & Winston, 1970), xvi.



Map 1.1a. South China, ca. 1990



Qinling Mountains, gradually spreading south into the Yangzi River valley around Suzhou and Hangzhou in the region more generally known as Jiangnan, or “south of the river.” By Tang times (618–907 CE), when a material and cultural civilization centered in Jiangnan arose and flourished, the southern extent of its world was marked by a low mountain range the Chinese at the time called the Nanling, the “southern ranges,” or “southern mountains.” To the south of the Nanling Range was the region known as Lingnan, the area “south of the mountains,” which was more backward and less culturally refined than Jiangnan. While not uninhabited and having been governed as part of the Chinese empire since the First Emperor, Qin Shi Huang Di, first conquered it around 230 BCE, still, in Song times, the authorities considered Lingnan sufficiently far from the cultured center of Chinese civilization to be an appropriate place to banish political enemies.

Among the most famous – if not the first³ – of political exiles to Lingnan was the renowned Song poet Su Dongbo. Sent in 1094 to serve as a county magistrate in Lingnan as punishment for some politically incorrect commentaries on the emperor, Su headed south from the capital in Kaifeng, pausing first around Nanjing and then continuing up the Yangzi River to Poyang Lake in Jiangxi. From Poyang Lake, Su headed south, up the Gan River toward the Nanling Mountains. From the base of the Nanling Range at the headwaters of the Gan River in Nan'an prefecture could be seen a saddle between the higher peaks of the Nanling, marking the Meiling Pass through the Dayu Mountains. According to his biographer, Lin Yutang, Su stopped to rest when he reached the pass: “It was a sentimental place where many travelers scribbled poems on the rocks. Standing there on the peak of the mountain, so close to the sky and the clouds, Su [Dongbo] felt that he was living in a dream world” (see Map. 1.1a).⁴

Centuries later, in 1793, Sir George Staunton and the rest of the MacCartney Mission to Beijing were among the first Westerners to follow the route south from Beijing, like Su Dongbo passing through Nanjing and up the Gan River to the Meiling Pass.⁵ In his book about the MacCartney Mission, Staunton described the view from the Meiling Pass looking south into Lingnan:

The mountain is clothed [on the Jiangxi side] with plantations of trees to its utmost height, from whence an extensive and rich prospect opens at once to

³ For a description of the political exiles in Tang Lingnan, see Schafer, *The Vermilion Bird*, ch. 3.

⁴ Lin Yutang, *The Gay Genius: The Life and Times of Su Tungbo* (New York: John Day, 1947), 346.

⁵ The MacCartney Mission was not the first group of Westerners to travel up the Gan River to the Meiling Pass. In 1549, several Portuguese were taken prisoner in Fujian and transported overland to Guilin, probably traveling over the Meiling Pass. See the chronicle of Galeote Pereira in Charles R. Boxer, *South China in the Sixteenth Century* (London: Hakluyt Society, 1953), esp. 30–32.

the eye. A gentle and uniform descent of several miles on every side, almost entirely clothed with lively verdure, and crowned with towns, villages, and farm-houses, is, as it were . . . “laid at the feet of the spectator,” whilst distant plains of unbounded extent, with mountains rising out of the horizon, terminate the view. Towards the southerly point of the compass appeared, however, a tract of waste and barren ground. The hills scattered over the plain appeared, comparatively to the vast eminence from whence they were viewed, like so many hay-ricks;⁶ as is, indeed, the distant appearance of many other Chinese hills. The town of [Nan’an], which the travelers had lately left, from their present situation, seemed merely to be a heap of tiles, while the river that passed by it was like a shining line. The mountain, so superior to the surrounding objects, must be of much higher elevation above the surface of the sea. It cannot be less than one thousand feet higher than the source of the [Gan River] . . . up which the party had navigated.⁷

From the Meiling Pass, both Su Dongbo and George Staunton looked south into Lingnan and commented upon the natural environment – the peak of the mountain, the verdant hills, the rivers – as well as the human elements in the environment: the villages, the farmhouses, and the path leading up to the pass. Their views of the south raise questions for us not only about the environment they saw – what were the forests like? What kind of animals lived in the forests? What was the climate like? – but also about the relationship between the people living there and the environment, for as perceived by these two observers, the environment was not purely “natural,” if by that we mean the absence of human influence, but included people in the landscape. Indeed, the very place from which they recorded their first views of China “south of the mountains” was in fact a human creation: the Meiling Pass.

The Meiling Pass had been “chiseled” (*zao*) by human labor during the Tang dynasty (in 716 CE) under the leadership of the engineer and state minister, Zhang Jiuling. A native of Shaozhou in northern Lingnan, a place some 90 miles southwest of the pass, Zhang ascended the ranks of the Tang bureaucracy and ultimately found himself positioned to be able to “improve” the pass, the main link between the Yangzi River valley and Lingnan. As might be imagined, the path over the Meiling Pass originally had been a single, rugged mountain trail winding over steep precipices. As Zhang Jiuling described it, Meiling was

Formerly, an abandoned road in the east of the pass,
Forbidding in the extreme, a hardship for men.
An unswerving course; you clambered aloft

⁶ In Chinese, this section of the Nanling Range is called the Dayu Ling, or “Big Grain-Stack Mountains,” a name conveying a similar image.

⁷ Sir George L. Staunton, *An Authentic Account of an Embassy from the King of Great Britain to the Emperor of China* (Philadelphia, 1799), vol. 2: 213–14.

On the outskirts of several miles of heavy forest,
 With flying bridges, clinging to the brink
 Halfway up a thousand fathoms of layered cliffs.⁸

As trade between Lingnan and areas to the north picked up after the Tang reestablished political unity and stability in the seventh century, the amount of silk and porcelain flowing into Lingnan increased, as did exports of furs, pelts, incense, and medicinal herbs. With more trade, the need to improve the route over the Meiling Pass arose, and in 716 CE state minister Zhang Jiuling began to cut a less steep, broader gradient over the Meiling Pass, lowering the solid rock by some 20 yards to create a pass about 3 yards wide (Figure 1.1). Not only did Zhang chisel the pass through solid rock, he paved the road on either side with small stones. The pass effectively linked the Gan River in Jiangxi with the North River in Lingnan. According to Ye Xian'en, the Tang opening of the Meiling Pass reoriented shipping routes in Lingnan: the North River became increasingly busy, while the former route through Guangxi fell into disuse.⁹ Singing the praises of his own work, Zhang Jiuling boasted after he cut the pass:

The several nations from beyond the sea
 Use it daily for commercial intercourse;
 Opulence of teeth, hides, feathers, and furs;
 Profits in fish, salt, clams, and cockles.¹⁰

Thus, to Chinese and even the first Western travelers overland from the Yangzi valley into south China, the Nanling Mountains do come first, if I may paraphrase Braudel. For at least a millennia, all of China “south of the mountains” was called Lingnan, an area stretching from westernmost Guangxi province into Fujian province on the east, and culminating in the sea or in tributary countries “beyond the south sea.” But the Nanling Mountains defined Lingnan not just in the Chinese sense we have been discussing so far, but also in terms of its physical geography.

Mountains and highlands

Three distinct ranges define the northern, western, and southwestern boundaries of Lingnan: the Nanling Mountains in the north, the Yunnan–Guizhou Plateau to the west, and the low coastal Yunkai Range in the south and southwest.

⁸ Translated and quoted in Schafer, *The Vermilion Bird*, 22.

⁹ Ye Xian'en, Tan Dihua, and Luo Yixing, *Guangdong hang yun shi* (Beijing: Renmin jiaotong chubanshe, 1989), 51–53.

¹⁰ Translated and quoted in Schafer, *The Vermilion Bird*, 22.



Figure 1.1. The Meiling Pass, 1994.

The Nanling Mountains, a sinuous belt of several ranges the Chinese sometimes called the “Five Ranges” (Wu Ling) because of the names of five sections of the range, divides the Yangzi valley from Lingnan in a generally east–west alignment between latitudes 25° and 26° N. Today, weathered and rounded or gullied, the Nanling Range averages about 3,000 feet above sea level, with some of the peaks rising to 6,000 feet. These mountains are,

however, fairly old and in terms of internal structure and genesis can be compared with the Appalachians in eastern North America.¹¹ Thus, as mountains they are not large or rugged, and they have served less as a barrier and more as an obstacle to commerce between central and south China.

In the grand scope of geological time, the area that is now south China was still covered with ocean some 200 million years ago when north China already had become continental land. When the uplift of south China began in the early to middle Jurassic, hundreds of millions of years of sediment had been deposited and formed into sandstone or limestone, and then tectonic pressures folded and refolded the sedimentary rocks into low mountains in a generally east-to-west configuration. The geological processes that created the Nanling Range were complex (and still not fully understood), resulting in three separate regions in the range. The western Nanling, separating the Guizhou Plateau from the Guangxi Basin, follows a mainly east–west orientation. In the central section, roughly from the border of eastern Guangxi westward to the Guangdong–Jiangxi border, the range zigzags southward and then northward again before resuming in its eastern section an irregular east–west alignment to the junction with the southeastern uplands.

Delineating the eastern edge of the Nanling Range, the southeastern uplands comprise a separate geologic formation and follow a southwest–northeast direction covering southern Jiangxi, the whole of Fujian, and eastern Guangdong province. Topographically distinct from the rest of Lingnan, the rivers of the southeastern upland have a distinctive pattern, flowing southeasterly in trellis-tributary patterns to the sea. Included in this region are Chaozhou and Jiaying prefecture in eastern Guangdong province. The border between the two regions is defined by the watershed between the Han River, which flows directly into the sea like the other river systems in the southeast coastal region, and the East River, which has its outlet in the Pearl River delta. To the Chinese, Lingnan thus included the area occupied by easternmost Guangdong province and all of Fujian province. Geologically and physiographically, though, that part of south China is distinct from the rest of Lingnan. To give the term “Lingnan” more geographic rigor than that used by Chinese observers, we will restrict it here to mean the Nanling Range and the three other physiographic subregions south of the mountains that for the most part lie within Guangdong and Guangxi provinces. Thus excluded from Lingnan proper are the Qing-era Guangdong prefectures of Chaozhou and Jiaying.¹²

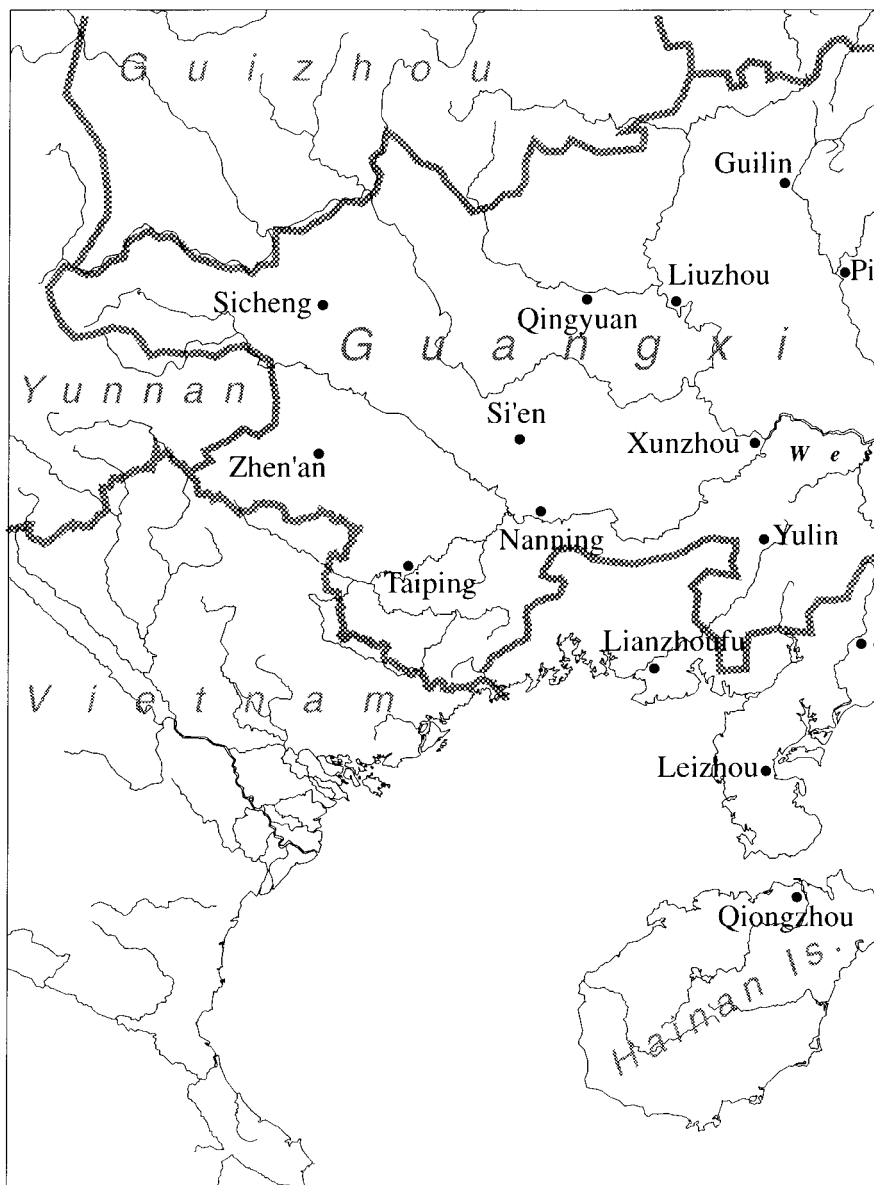
¹¹ K. J. Hsü, “Origin of Sedimentary Basins of China,” in X. Zhu, ed., *Chinese Sedimentary Basins* (Amsterdam: Elsevier, 1989), caption to Fig. 17.2 on p. 211.

¹² This definition of Lingnan follows that developed by G. William Skinner in two articles, “Regional Urbanization in Nineteenth-Century China,” and “Cities and the Hierarchy of Local Systems,” both in G. William Skinner, ed., *The City in Late Imperial China* (Stanford: Stanford University Press, 1977), 282.

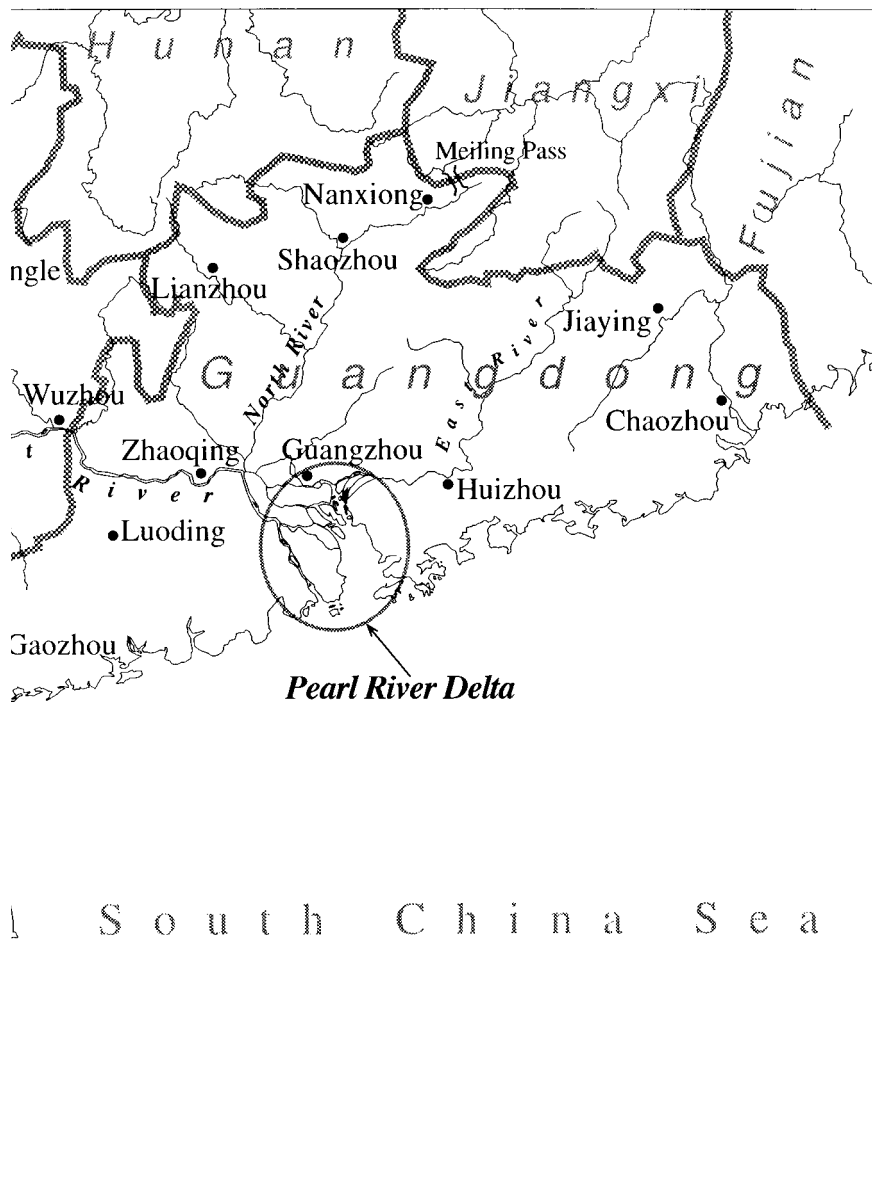
The Yunnan–Guizhou plateau rises in the western part of Guangxi province, and to the south a low coastal range of mountains arc from present-day Vietnam through the border with Guangdong, enclosing the Guangxi Basin. Most of the surface of the basin is a tableland with an average elevation of about 1,000 feet, although in the western part of the basin a sharp step up in elevation toward the Yun–Gui plateau is marked by the Yao Hills, which run north-northeast on a line just to the west of the cities of Nanning and Liuzhou. The Guangxi Basin is essentially the drainage basin for the West River, with the tributaries all ultimately converging at the city of Wuzhou into a single trunk. The West River basin constitutes a well-defined subphysiographic region, connected to Guangdong province through the single point in Wuzhou where the West River flows out of Guangxi and into Guangdong (see Map 1.1b).

The southern border of Lingnan is a long coastal zone of varying width running southwest from the Pearl River delta to the Vietnam border, separated from the rest of Lingnan by a range of low folded sandstone rocks metamorphosed by granitic or igneous intrusions. The coastal belt, largely the Leizhou Peninsula, contains considerable lowlands drained by short rivers flowing into the South China Sea or the Gulf of Tonkin. Some 15 miles offshore lies Hainan Island, an essentially mountainous continuation of the same geological structure as the southeastern coastal region, with peaks in the central range reaching 5,500 feet. Narrow alluvial lowlands, mostly in the north facing the Leizhou Peninsula, ring the island.

As a physiographic unit, then, Lingnan is composed of subregions that more or less fit together. I say “more or less” because the region is not simply a basin surrounded by mountains, as one might conceive of Sichuan province or a single river valley. Rather, two features constrain the physical unity of Lingnan. First, the low coastal range that forms the southern rim of the Guangxi basin forms a watershed, forcing the West River drainage system to remain within Guangxi and dividing southwestern Guangdong from the rest of Lingnan. Without this low range, the West River drainage system might well have flowed directly into the Gulf of Tonkin. While denied a coastal outlet by the low hills, the West River constituted the most important linkage of Guangxi to Guangdong. Physiographically, this single connection between the Guangxi Basin and the Pearl River delta may be seen as a weak link, formed only because of the flow of water into the West River drainage system. One might think of the West River basin as being precariously stuck to western Guangdong with a single pin near the city of Wuzhou. Without sufficient amounts of water, the Guangxi Basin may well not have been connected to the rest of Lingnan at all. And the reason there is plenty of water to fill the rivers – usually, that is – is because of the climate of south China.



Map 1.1b. South China, ca. 1820



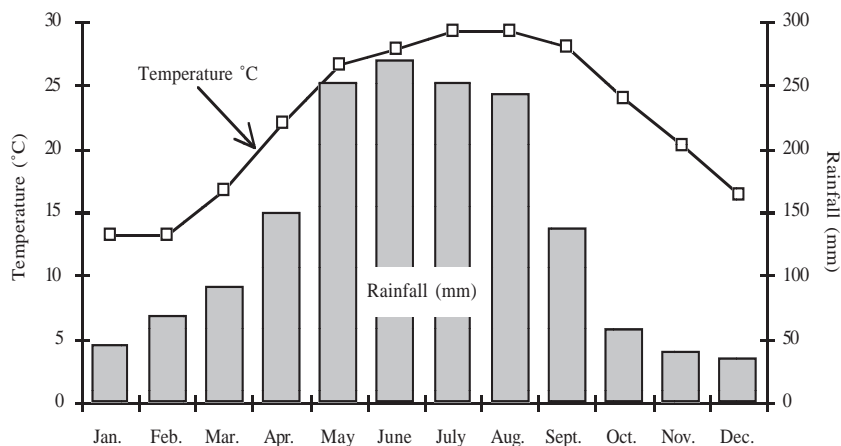


Figure 1.2. Mean monthly temperature and rainfall at Guangzhou. Source: International Rice Research Institute, *Rice Research and Production in China* (Los Banos, Philippines: IRRI, 1979), 25.

Climate

The present climate of Lingnan is classified broadly as subtropical to tropical; Guangdong and Guangxi provinces straddle the Tropic of Cancer, while the more southerly positioned Leizhou Peninsula and Hainan Island have a tropical climate.¹³ Current monthly mean temperatures throughout the region range from about 10 to 30°C, and plentiful rainfall (about 1,600mm annually) falls mostly during the agricultural growing season. Although the region is not frost free, the growing season ranges from 250 to 320 days (10°C is the minimum temperature for growing rice).¹⁴ Figure 1.2 summarizes present climatological data (temperature and rainfall) for the city of Guangzhou.

While the Nanling Mountains separate Lingnan from central China, too much emphasis should not be placed on the mountains as a climatic dividing line, for the dominant feature of climate throughout China, and not just Lingnan, is the summer and winter monsoons. As we have seen, the Nanling Range actually is not very high, allowing for a significant exchange of air

¹³ For a classification of China's climatic zones, see Zhang Jiacheng and Lin Zhiguang, *Climate of China*, Ding Tan, trans. (New York: Wiley, 1992), 285.

¹⁴ In northern Guangdong province, because of higher altitudes and exposure to cold currents in the winter, there are only about 225 frost-free days, and the growing season is hence shorter. See International Rice Research Institute, *Rice Research and Production in China* (Los Banos, Philippines: IRRI, 1979), 25.

masses from north to south over the mountains and vice versa. Not high enough to be a climatic barrier, the low-lying Nanling Range enables monsoon winds to flow north into central China instead of being blocked or directed elsewhere. Each winter, a continental air mass located in Siberia sends cold, dry winds from the north, while in the early summer through autumn winds from the south and southeast bring moisture-laden air from the Pacific Ocean over the Asian landmass, defining China's monsoonal climate.¹⁵

The summer monsoon has a definite annual cycle and brings 80 percent of China's rain, nearly all of it in the summer months. In the winter months, a cold polar front with dominant winds blowing from the inland northwest blocks the moisture-laden southeasterly winds from reaching China. China's rainy season begins in the spring as the polar front recedes northward with warmer temperatures. In late spring, the clockwise circulation of air around the high pressure system brings rains to south China, and in early summer the high directs rain toward central China and the Yangzi Valley. By July and August, the northernmost retreat of the subtropical high brings rain to north China. With cooling northern hemisphere temperatures in the fall, the advancing polar front pushes the Pacific subtropical high southward, and in September and October typhoon rains hit south and southwest China. As the polar front advances further in the winter months, nearly all of China is rain free (except for drizzle in the Yangzi Valley).¹⁶

When the North Pacific subtropical high moves in this regular annual cycle, "normal" and predictable rainfall patterns appear. For Lingnan, the monsoon brings a considerable amount of rain, ranging from over 80 inches in Hong Kong on the coast to 51 inches in Wuzhou and 67 inches in Guangzhou. By any standards, that is a lot of precipitation. Not only is there a lot of rain, it is concentrated in just five or six months of the year, from April through October. Since neither evaporation nor soil permeability or retention could contain the vast quantities of water that falls upon Lingnan, it runs off the surface and fills the natural lines of drainage. As Fenzel succinctly and aptly concluded, "consequently, extended river systems had to develop themselves in order to ensure the removal of the water."¹⁷

¹⁵ A monsoon is defined as "alternating winds between winter and summer, the direction of which varies more than 120°." Manfred Domrös and Peng Gongping, *The Climate of China* (Berlin: Springer, 1988), 41.

¹⁶ This paragraph is based on Zhang Jiacheng and Thomas B. Crowley, "Historical Climate Records in China and the Reconstruction of Past Climates," *Journal of Climate* 2 (Aug. 1989): 835. See also Zhu Kezhen and Zhang Baogun, *Zhongguo zhi yuliang* (Beijing: Ziyuan weiyuan hui, 1936), 1-12.

¹⁷ G. Fenzel, "On the Natural Conditions Affecting the Introduction of Forestry as a Branch of Rural Economy in the Province of Kwangtung, Especially in North Kwangtung," *Lingnan Science Journal* 7 (June 1929): 72.

Table 1.1. *The Pearl River drainage basin, compared with the Yangzi and Yellow Rivers*

River	Drainage area (sq. km)	Flow (cu. m/sec.)	Suspended (kg/cu. m)	Silt carried (kg/sec.)	Silt carried (ton/sq. km/yr.)
Yangzi River	1,705,383	28,500	0.575	16,388	1,686
Yellow River	687,869	1,350	37.700	50,895	293
West River	329,705	6,294	0.321	2,020	201
North River	38,363	1,280	0.126	161	n.a.
East River	25,325	697	0.136	95	n.a.
Pearl River system	393,393	8,271	<0.321	2,276	>201

Source: Chen, *Zhongguo ziran dili*, vol. 4, *Dibiao shui*: 71–75, 108–11.

Rivers and Soils

Lingnan’s “extended river systems” consist primarily of three rivers – the East, the North, and the West – which converge in the Pearl River delta and then empty into the South China Sea. As can be readily seen from Map 1.1b, the drainage basin of the West River is the largest and most important, followed by those of the North and the East Rivers. The catchment basins and the structure of these major river systems conform to the topography of Lingnan, with most of the river systems contributing to the flow of water into the Pearl River. Shorter, smaller rivers in southwest Lingnan flow directly into either the South China Sea or the Gulf of Tonkin. While the West River system constitutes the largest drainage in Lingnan, in comparison with other drainage systems in the rest of China, it ranks third behind the Yellow River and Yangzi River systems.

Besides the length of its rivers and area of its drainage basins, the Lingnan system exhibits three other characteristics that differentiate it from the Yellow and Yangzi Rivers. First, the amount of water flowing into Lingnan’s river systems fluctuates wildly with the monsoon, rising rapidly in the rainy season and falling equally dramatically in the dry season.¹⁸ A sense of how dramatic the swings are can be seen in the West River water level at Wuzhou. As will be recalled, by the time the West River reaches Wuzhou, the water from all its tributaries in Guangxi has entered the stream; from Wuzhou, the West River spills into Guangdong province. At flood stage, up to 2 million cubic feet per second flow past Wuzhou, with the water level an average of 60 feet above the dry-season level. In extremely wet years, the West River could rise even higher;

¹⁸ For the comparative data, see Chen Binyi, editor in chief, *Zhongguo ziran dili*, vol. 4, *Dibiao shui* (Beijing: Kexue chubanshe, 1981), 73–77.

in 1915, for instance, the water rose to 82.3 feet above the dry-season level, and when the West River spilled into Guangdong province that year, massive flooding occurred.¹⁹

Second, the Lingnan rivers carry (and have carried) the least amount of silt of any major river system in China (see Table 1.1). Although the Pearl River drainage system (which includes the West, North, and East Rivers) is the third largest in China, it carries but 12 percent of the amount of silt in the Yangzi River, though this is partly because of the greater flow of the Yangzi system.²⁰ Before the forest cover of Lingnan was removed (a story I take up in later chapters), anecdotal evidence from the Tang era indicates that the rivers ran clear.²¹ But even in the nineteenth and twentieth centuries, after the forests had been removed, the hills were not barren, but covered with a tough grass that held much of the soil in place. Comparatively, then, the Pearl River drainage system washed less soil to the ocean than the Yellow and Yangzi Rivers, but it carried enough silt that it settled out and began forming a delta.

Indeed, during the summer monsoon, enough soil was washed into the rivers, especially the West, to lend them a muddy appearance. "So," in the words of a twentieth-century observer,

during the summer months, the swelled rivers carry along with their brown, turbid waters enormous quantities of sedimentary materials and, in the lower courses, where the rivers transverse the delta at a much slower speed, and split up into a network of channels, these materials are deposited quickly. In this deposition, however, though it leads to a steady growth of the land at the cost of the rivers and the back waters of the bays, which gradually lead over to the open sea, a strict boundary between the firm land and the water is lacking nearly everywhere, and extremely high waters inundate even areas which have long since been regarded as finally dry and secure from floods.²²

The amount of silt carried by these rivers thus was significantly less than that carried by the Yellow River, but the Pearl River system nonetheless did carry enough silt to be deposited at the mouths of the rivers to form a delta. Moreover, the amount of silt varied from one historical epoch to another as people settled and cleared the land. Indeed, the pace by which the Pearl River delta formed, as I will discuss in more detail in the next chapter, hastened concurrent with the clearance of land in the upper reaches of the North and West Rivers, which increased the amount of silt flowing downstream.

¹⁹ G. W. Olivercrona, "The Flood Problem of Kwangtung," *Lingnan Science Journal* 3, no. 1 (1925): 1-2.

²⁰ Chen, *Zhongguo ziran dili*, vol. 4, 111.

²¹ Zeng Zhaoxian, "Cong lishi dimaoxue kan Guangzhou cheng fazhan wenti," *Lishi dili* 4 (1986): 29.

²² Fenzel, "On the Natural Conditions Affecting the Introduction of Forestry," 74.

A third difference with the Yellow and Yangzi Rivers is that because of the amount and concentration of the rain in just a few months, the river beds often lie in valleys with sides cut too steep for cultivation, a characteristic particularly evident throughout much of the West River drainage system in Guangxi,²³ in the upper reaches of the North River, and in the East River east of Huizhou. Had the climate provided a more even or less intensive rainfall, the rivers of Lingnan might have eroded the old hills and mountains at a more leisurely pace, creating wider, more level valleys. But the particular combination of Lingnan's topography with the climatic patterns conspired on the one hand to leave little valley land in Lingnan fit for cultivation, but on the other to create the alluvial soils that have been captured to create the Pearl River delta.

The Pearl River Delta. Carrying considerably less silt than China's other major rivers, the West, North, and East Rivers nonetheless converged to create a common delta in central Guangdong. These three rivers at one time had independent outlets, but subsidence of the coastal region after the Jurassic lifting created a common bay into which they all emptied. The subsidence left the tops of many of the original hills above sea level, now at most a thousand feet, but the alluvium brought down by the rivers slowly filled in the bay, creating the delta. With its "curious combination," as the British Naval Intelligence termed it, of alluvium, hills, islands, and bay, the Pearl River delta is not a true or pure delta, but a rather unique structure.²⁴ Indeed, in terms of geologic time, the Pearl River delta is a very recent creation. Just 3,000 years ago, the delta was perhaps half its current size and even 1,000 years ago had not increased much beyond that; in the past millennium, though, the Pearl River delta has doubled in size, largely as a result of human action. How that happened is an interesting story that will be told in the next chapter; suffice it to say here that the Pearl River drainage system carried so little silt that the delta originally formed very slowly, with the pace quickening only when the lower reaches of the West, North, and East Rivers were altered to meet human needs, and pioneers began to settle in the delta.

Navigation. Lingnan's rivers not only carried sediment to be deposited in the alluvial plains; they also carried boats. Navigation on the extensive river system provided the basic means of communication, travel, and trade through the otherwise impassable folded hills of the Lingnan interior. Each of the

²³ Zhao Songqiao, *Geography of China: Environment, Resources, Population, and Development* (New York: Wiley, 1994), 157.

²⁴ Great Britain Naval Intelligence Division, *China Proper*, vol. 1, *Physical Geography, History, and Peoples*, Geographical Handbook Series (London, 1941), 119–22. Because it is a filled-in bay rather than a true delta, this source calls the Pearl River delta an "embayment."

major rivers was navigable, if by that we mean that small dugouts or rafts could float downstream until the river widened and deepened to accommodate boats of deeper draft. The MacCartney Mission, for instance, took small boats from Nanxiong downriver to Shaozhou, where they boarded larger boats to complete the journey to Guangzhou, passing through some stretches of narrows where the North River coursed over rapids. Rapids and shallower water could be found on the East River above Huizhou and on many of the tributaries to the West River in Guangxi.

It was of course easier going downstream than up. Sailing junks could maneuver in the Pearl River estuary and up the West River most of the way to Wuzhou, but after that poles and pullers were needed. The same was true for the North River. Likewise, to take the Gui River upstream from Wuzhou to Guilin was not impossible, but it was “inconvenient,” if I may borrow a phrase from current Chinese bureaucratic usage. In 1729, for instance, when the Manchu governor-general of Yunnan and Guizhou provinces, E-er-tai, toured Guangxi soon after it was added to his bailiwick and wanted to travel from Yunnan to Guilin, his route took him from the Yunnan–Guangxi border downstream through Bose to Nanning, where he crossed overland through Liuzhou to Guilin. “Large boats (*da chuan*) can travel from Bose through Nanning to Wuzhou and [upriver] through Pingle to Guizhou,” he said. “But the route is rather roundabout.”²⁵

The monsoons also regulated the shipping calendar. Clearly, when the rivers were at flood stage in the spring and summer with 2 million cubic feet per second flowing through Wuzhou, travel either up- or downstream was difficult and dangerous. But the dry season also posed its challenges, as water levels in the channels dropped, sometimes to levels too low for boats. And when those boats carried rice down the rivers to markets, low water levels affected rice prices: “Grain prices are rising,” an official reported in early 1763. “Investigation shows that with clear days in the winter, the rivers are dry or shallow, and outside trade is minimal. Also, it is difficult to transport and sell rice . . . In the spring when rains raise the rivers, [prices] for rice in the cities and villages alike will fall uniformly.”²⁶

Linkages to the Yangzi River System. The Lingnan river system was such an important part of the transportation system of the entire Chinese empire that from very early times links were established between it and the Yangzi River valley. The earliest was the construction of the Ling Qu Canal connecting the upper reaches of the southward-flowing Li River above Guilin with

²⁵ Memorial dated YZ8.1.13 in *Gongzhongdang Yongzheng chao zouzhe*, Gugong bowuyuan, comp. (Taipei: Guoli gugong bowuyuan, 1977–88), vol. 15: 463–67. Hereafter cited as YZCZZ.

²⁶ Memorial dated QL28.12.18 in *Gongzhongdang Qianlong chao zouzhe*, Gugong bowuyuan, comp. (Taipei: Guoli gugong bowuyuan, 1982–86), vol. 20: 99–100. Hereafter cited as QLCZZ.

the Xiang River, which flowed north through Hunan province and into the Yangzi River. Built initially around 230 BCE by Shi Lu, an engineer in Qin Shi Huang Di's army, the Ling Qu was (and remains) a masterpiece of ingenuity. Even an extended description of the Ling Qu Canal cannot do justice to the way in which the Xiang and Li Rivers were connected, so suffice it to say that Joseph Needham translated the character in its name (Ling) as "magic," rather than the less grandiose but still apt "ingenious." Used first to transport Qin troops and warships into Lingnan, the Ling Qu was later used to transport goods to and from Lingnan from north China via the Yangzi River.²⁷

Natural processes could do only so much with the raw material of Lingnan in providing a river system adaptable to human use. The natural river systems endowed Lingnan with a transport network upon which to move goods from one part of the region to another, facilitating agricultural specialization and the shipment of bulk items like grain down the West River to the city of Guangzhou, with accessible sources of water for irrigation and with a mechanism for creating rich soils, all of which could be considered advantageous to human settlement of the region. Over the millennia the vast amount of water flowing into the West River basin found an outlet through a fault in hills near the city of Wuzhou, thereby not only draining the basin, but establishing a water link between the two major parts of Lingnan. But for the people inhabiting Lingnan, these natural processes proved insufficient in linking Lingnan to the rest of China, and so people created two additional links: the Ling Qu Canal and the Meiling Pass.

The Lingnan river system thus was not ideal. Besides not connecting Lingnan with the Yangzi River valley to the north, the rivers cut mostly deep ravines into the hills, leaving little level space for alluvial valleys to spread out, thereby limiting the amount of land that could be given over to agriculture and challenging those who would attempt to inhabit the flood plains. The gush of water through the system brought by the summer monsoon virtually ensured flooding wherever the rivers could overflow their banks, thereby depositing their alluvium, a potentially fertile and rich soil.

Soils. Soil is composed of a mixture of varying proportions of decomposed rock, decaying organic matter, and living organisms, which then interact to form various chemical compounds.²⁸ But despite the fact that, in Lingnan, rocks of various kinds – mostly granites, sandstone, limestone –

²⁷ Joseph Needham, *Science and Civilization in China*, vol. 4, part 3, *Physics and Physical Technology: Civil Engineering and Nautics* (Cambridge University Press, 1971), 299–306.

²⁸ This section is woefully brief and does not do justice to the complexity of soils. As Edward O. Wilson recently observed: "The very soils of the world are created by organisms. Plant roots shatter rocks to form much of the grit and pebbles of the basic substrate. But soils are much

contribute different bases for the soils, the rainfall and humidity exercise the greatest influence on the kind of soil that predominates. Because of the large amount of rainfall, soluble materials in the upper layers of the soil leached into lower levels, leaving slightly acidic soils that are red or brown in color. When exposed to the air, these soils either develop a hard crust upon which little vegetation can grow, or contain a hardpan called “laterite” just below the surface that can be exposed by erosion; this may have been what Staunton saw from the Meiling Pass when looking south he described “a tract of waste and barren ground.” The original vegetation probably had been burned off, exposing the earth to the rains and eroding the topsoil down to the hardpan.

The soil covering the hardpan was generally yellow or red podzolized earth, a soil type found throughout south China, including Lingnan. None are particularly fertile and, with the hardpan, are at best difficult to work. Tropical soils generally are poor, and those in Lingnan were no different. The reason for the infertility is that most of the organic matter in tropical ecosystems is tied up in the trees that constitute the tropical forest, and the nutrients from decaying matter are quickly leached from the soil by the heavy rainfall.

Forests and Wildlife

In the 1930s, according to estimates made at the time by Chinese and Western botanists, cultivated land took up about 10–15 percent of the land surface of Lingnan, while most of the rest of Lingnan – being hills or mountains – was savanna, and only a very small proportion, maybe as little as 1 percent but perhaps as much as 5 percent of the land, was forested. However much forest did exist in the 1930s, the scientists agree that most was a secondary growth of pine forests – the scrubby-looking Mason’s pine (*Pinus massoniana*, see Figure 1.3) – sometimes intermixed with some broadleaves.²⁹ To those in the 1930s looking at the vast expanse of treeless hills, the question was whether the

more than fragmented rock. They are complex ecosystems with vast arrays of plants, tiny animals, fungi, and microorganisms assembled in delicate balance, circulating nutrients in the form of solutions and tiny particles. A healthy soil literally breathes and moves. Its microscopic equilibrium sustains natural ecosystems and croplands alike.” Edward O. Wilson, *The Diversity of Life* (Cambridge, MA: Harvard University Press, 1992), 308. Similarly, Donald Worster has written, “Few . . . would deny that a topsoil is an organization of life, fundamentally akin to a mountain forest, a coral reef, or a school of minnows.” Donald Worster, “A Sense of the Soil,” in Worster, *The Wealth of Nature*, 82. For an extended argument about the centrality of soil conservation in the rise and fall of civilizations, see Edward Hyams, *Soil and Civilization* (New York: Harper Colophon, 1976). The brief summary provided here of the soils of Lingnan is based upon: Great Britain Naval Intelligence, *China Proper*, vol. 1: ch. 7, and to a lesser degree upon Fenzel, “On the Natural Conditions Affecting the Introduction of Forestry,” 50–63.

²⁹ Ling Daxie, “Wo guo senlin ziyuan de bianqian,” *Zhongguo nongshi* 2 (1983): 34–35.